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(54) Electrical heater

(57) An electrical heater (10) consists of a rigid panel (12) of high thermal conductivity material, within which are embedded one or more resistance wires (14) running parallel to a surface of the panel and electrically insulated from the panel. The panel provides a large surface area at a substantially uniform temperature from which heat is transferred to the environment. The tight fit of the wires within the panel ensures that in operation the temperature of the wires may exceed the panel temperature by as little as about 25 K. One surface may have a high emissivity (eg painted block) and the other a low emissivity.

Fig.2.

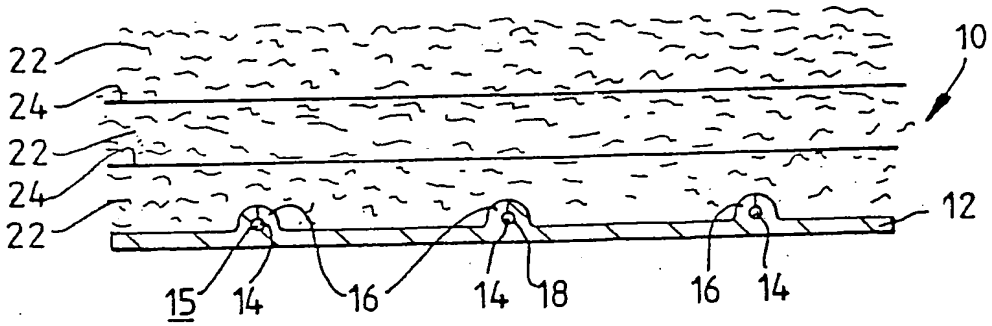

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Fig.1.

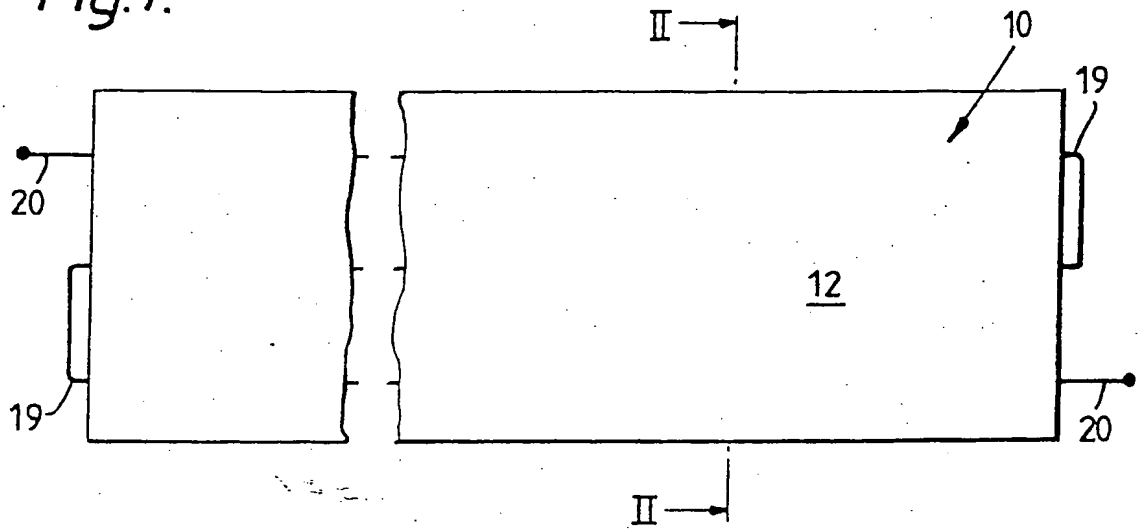


Fig.2.

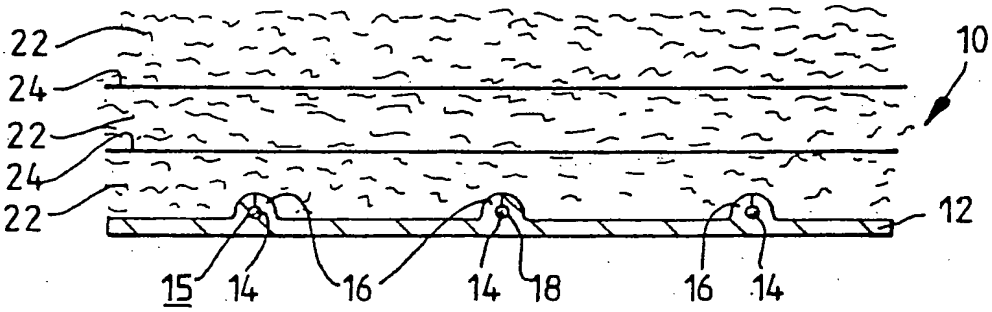


Fig.3a.

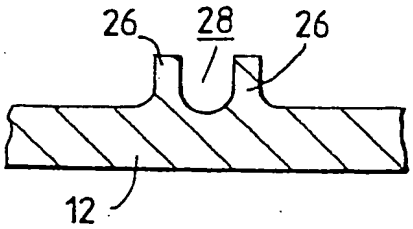
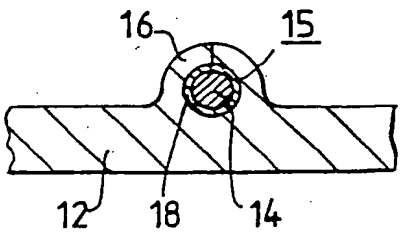


Fig.3b.



Electrical Heater

This invention relates to an electrical heater, particularly although not exclusively useful for providing heat to a room, and to a method of manufacture of such a heater.

One currently used type of electrical heater includes a length of resistance wire wound helically around the outside of a cylindrical ceramic support. In operation the wire becomes red hot and transfers heat directly to its surroundings principally by radiation and by convection. Such a heater can pose a hazard, for example to young children, as the wire is exposed and is at such a high temperature. Another currently used electrical heater incorporates a hollow panel filled with a heat transfer liquid such as an oil, and an electrical resistance element arranged to heat the liquid. The external surfaces of this type of heater typically do not exceed about 80°C in operation, and so pose less of a hazard; but this type of heater is generally more expensive than the first mentioned type.

According to the present invention there is provided an electrical heater comprising a rigid panel comprising a material of high thermal conductivity, and defining a duct therein extending parallel to a surface of the panel, a resistance wire enclosed by an electrically insulating material and extending in a tight-fitting manner through the duct so as to be embedded in and completely surrounded by the material of the panel.

In the preferred embodiment the panel is of aluminium, while the resistance wire is covered by a layer of braided glass fibre or ceramic fibre insulation. Typically the external face of the panel is at between 100°C and 450°C,

preferably about 250°C, during operation, and transfers heat to its surroundings by radiation and convection. The panel is maintained at this temperature by heat transfer from the resistance wire, which is typically between about 10 and 200 K preferably about 50 K hotter than the maximum panel temperature, the heat transfer being by conduction and radiation from the wire to and through the insulation into the aluminium of the panel. Because the aluminium encloses the insulation completely, heat transfer into the panel is effective, and so the temperature of the wire is minimized for a particular power generation.

The panel may define a plurality of such ducts extending parallel to each other, adjacent ducts being between 15 and 150 mm apart, preferably about 50 mm apart; and the panel is desirably between about 2 mm and 15 mm thick, and may vary in thickness, being thicker in the vicinity of the ducts. Consequently the external face or faces of the panel are at substantially uniform temperature during operation.

In many situations heat emission is desired in only one direction from the heater, and in such a situation one face of the panel is desirably provided with a high emissivity surface and the opposite face provided with a low emissivity surface, the values of emissivity typically being above 0.8 and below 0.3 respectively. The high emissivity surface may be provided by an anodised surface, or by coating a face with a matt black layer. The low emissivity surface may in addition be covered with a radiation-inhibiting insulating material such as microporous thermal insulation material, or alternating layers of shiny metal foil and of mineral or glass fibre insulation.

The present invention also provides a method of manufacture of such a heater wherein the high thermal conductivity material of which the panel is formed is

deformed plastically into close contact with an electrically insulated resistance wire so as to surround completely the resistance wire.

The panel might be co-extruded with the insulated wire; or the panel material might be shaped in a die, when in a molten or solidifying state, so as to enclose the insulated wire; or the insulated wire might be placed in a channel extending across a face of a panel and the channel walls swaged or deformed to enclose the wire.

The invention will now be further described by way of example only and with reference to the accompanyinhg drawings, in which:

Figure 1 shows a plan view of the underside of an electrical heater;

Figure 2 shows a sectional view of the heater of Figure 1 taken along the line indicated as II-II; and

Figures 3a & b show successive stages in the manufacture of the heater of Figure 1.

Referring to Figures 1 and 2 there is shown a radiant heater 10 suitable for installation below a ceiling of a room. The underside of the heater 10 consists of a high emissivity, black-painted, aluminium panel 12, rectangular in shape, 180 mm wide and 1.0 m long, and 3 mm thick. The heater 10 incorporates three resistance wires 14 (see Figure 2) which extend the length of the panel 12 in ducts 15 defined within ridges 16 on its upper surface, parallel to each other and 60 mm apart. As can be seen more clearly in Figure 3b, each wire 14 is electrically insulated from the panel 12 by braided glass fibre insulation 18. The

three wires 14 are connected in series, electrically, by copper wire connectors 19 at each end of the panel 12, and terminals 20 are provided, one at each end, for connection to an electric power supply. The upper surface of the panel 12 is reflecting, so as to have a low emissivity of less than 0.3, and is insulated by three layers of glass fibre insulation 22 separated by two sheets 24 of low emissivity aluminium foil.

Referring to Figures 3a and b, the panel 12 is initially made by an extrusion process, with three pairs of parallel upstanding walls 26 defining channels or grooves 28 on its upper surface (as in Figure 3a; only one such groove 28 is shown). The wires 14 are then placed in these grooves 28, and the panel 12 is passed through a die, which plastically deforms the walls 26 so as to define the ducts 15 within the ridges 16, and to embed the wires 14 in the panel 12 (as in Figure 3b), so the wires 14 fit tightly within the ducts 15.

In use, the heater 10 is installed below a ceiling of a room, and is connectd to a power supply. The wires 14 heat up to a temperature typically between about 300 and 500°C; because of the close contact between each wire 14 and the surrounding duct walls, heat is efficiently transferred to the panel 12, the lower surface of which reaches a temperature between about 150 and 300°C, typically 250°C, this temperature being substantially uniform because aluminium has a high thermal conductivity. Very little heat is lost from the upper surface of the panel 12 because of the low emissivity upper surface, and the insulation 22 and the foil sheets 24, which inhibit heat transfer by both conduction and radiation. Most of the heat generated by the wires 14 is therefore dissipated from the lower surface of the panel 12, chiefly by thermal radiation.

It will be appreciated that the thermal power emitted by the heater 10 depends upon both the temperature and the surface area of the panel 12. Because the temperature of the wires 14 may exceed that of the panel 12 by as little as about 25 K, the power dissipation can be varied over a wide range, from 1 kW or less, up to about 2 kW (for this size of panel) without the wires 14 becoming red hot.

It will be understood that for some applications, no insulation 22 or foil sheets 24 are required, and both faces of the panel 12 might be provided with a high emissivity coating. Where thermal insulation of one face is required, this might alternatively be provided by a material such as microporous insulation (comprising silica aerogel and an opacifier) which suppresses both radiation and convection.

Claims

1. An electrical heater comprising a rigid panel comprising a material of high thermal conductivity, and defining a duct therein extending parallel to a surface of the panel, a resistance wire enclosed by an electrically insulating material and extending in a tight-fitting manner through the duct so as to be embedded in and completely surrounded by the material of the panel.

2. A heater as claimed in Claim 1 wherein the panel defines a plurality of said ducts, each accommodating a respective said wire.

3. A heater as claimed in Claim 1 or Claim 2 wherein one surface of the panel is of high emissivity for infra-red radiation.

4. A heater as claimed in Claim 3 wherein the opposite surface of the panel is of low emissivity for infra-red radiation.

5. A heater as claimed in Claim 4 also comprising heat insulating means covering the low emissivity surface of the panel.

6. A method of making an electrical heater comprising an electrically insulated resistance wire and a panel of high thermal conductivity material, wherein the panel material is deformed plastically into close contact with the insulated wire so as to surround it completely.

7. An electrical heater substantially as hereinbefore described with reference to, and as shown in, Figures 1, 2 and 3b of the accompanying drawings.

8. A method of making an electrical heater substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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